



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

AF-2800

In re the Application of:

Donald C. Abbott, et al.

Docket No.: TI-29679

Serial No.: 09/733,718

Examiner: Cao, Phat X.

Filed: 12/08/00

Art Unit: 2814

For: Leadframes for High Adhesion Semiconductor Devices and Method of Fabrication

#12 Appeal Brief

M. Brunson

4/23/03

Appeal Brief

Assistant Commissioner of Patents
Washington, DC 20231

MAILING CERTIFICATE UNDER 37 C.F.R. §1.8(A)

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4-10-03

Jackie McBride
Jackie McBride

Dear Sir:

Pursuant to the Notice of Appeal mailed 02/10/03, Appellants submit this appeal brief in triplicate. The Commissioner is hereby requested and authorized to charge any fees necessary for the filing of the enclosed papers to deposit account number 20-0668 of Texas Instruments Incorporated.

Real Party in Interest

The real party in interest is Texas Instruments Incorporated.

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Related Appeals and Interferences

No related appeals or interferences are known to Appellant.

Status of Claims

Claims 1-16 and 21-24 are pending and are the subject of this appeal.

Claim 21 stands rejected under 35 U.S.C. 102(e) as being anticipated by Lee, et al. (U.S. Patent No. 6,232,651.)

Claims 1-3, 5, 9, and 21-23 stand rejected under 35 U.S.C. 102(b) as being anticipated by Kim, et al. (U.S. Patent No. 5,767,574).

Claims 21-23 stand rejected under 35 U.S.C. 102(b) as being anticipated by Abys, et al. (U.S. Patent No. 5,360,991).

Claims 4, 6, 10, and 11 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Kim.

Claims 8 and 12-16 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Kim in view of Tsuji, et al. (U.S. Patent No. 5,521,432).

Claims 7 and 24 stand objected to as being dependent upon a rejected base claim, but have been indicated as being allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Status of Amendments

It is unclear whether the paper filed by Appellant under 37 CFR 1.116 on 12/16/02 is entered or unentered since the Examiner checked box 7 on the Advisory Action form, but did not then check box a) or b). Since the only amendments made to the claims in the paper filed by Appellant were to correct grammatical mistakes, Appellant assumes herein that the paper was entered.

Summary of Invention

One embodiment of the invention is a leadframe for use in the assembly of integrated circuit chips. The leadframe includes a base metal structure (201 in Figure 2) having an adherent layer of nickel 204 covering the base metal, an adherent film of palladium 205 on the nickel layer, and an adherent layer of palladium 206 on the palladium film selectively covering areas of the leadframe suitable for bonding wire attachment and solder attachment. See the specification from the third paragraph (line 21) of page 13 to the top (line 2) of page 15.

Another embodiment of the invention is a semiconductor device that includes a leadframe (see Figure 4). The leadframe 401 includes a chip mount pad 402 for an integrated circuit chip 403 and a plurality of lead segments 405, each segment having a first end 405a near the mount pad and a second end 405b remote from the mount pad. The leadframe has an adherent layer of nickel 407 as well as an adherent palladium film on the nickel layer. The leadframe further includes an adherent layer 408, 409 of palladium on the palladium film selectively covering the second ends of the lead segments in a thickness suitable for solder attachment. The adherent layer of palladium also selectively covers the bonding wire attachment areas on the first ends of the lead segments in a thickness suitable for bonding wire attachment. The device also includes an integrated circuit chip 403 attached to the mount pad; bonding wires 411 interconnecting the chip and the first ends 405a of the lead segments; and encapsulation material 413 surrounding the chip, bonding wires and the first ends of the lead segments, while leaving the second ends 405b of the lead segments exposed. See the specification from the second paragraph (line 17) of page 18 to the top (line 4) of page 20.

Still another embodiment of the invention includes a semiconductor device that includes a leadframe. The leadframe includes a first layer of noble metal covering the leadframe; and a second layer of the noble metal covering portions of the first layer of the noble metal, wherein the first layer of the noble metal is thinner than the second layer of the noble metal. Yet another embodiment of the

invention is a semiconductor device that includes a leadframe including a film of palladium on the leadframe and a layer of palladium covering portions of the film of palladium. See again Figure 2, particularly layers 205 and 206, as well as the paragraph in the specification bridging pages 13 and 14 in addition to the remainder of page 14.

Issues

1. Whether Claim 21 is patentable under 35 U.S.C. 102(e) over Lee, et al. (U.S. Patent No. 6,232,651.)
2. Whether Claims 1-3, 5, 9, and 21-23 are patentable under 35 U.S.C. 102(b) over Kim, et al. (U.S. Patent No. 5,767,574).
3. Whether Claims 21-23 are patentable under 35 U.S.C. 102(b) over Abys, et al. (U.S. Patent No. 5,360,991).
4. Whether Claims 4, 6, 10, and 11 are patentable under 35 U.S.C. 103(a) over Kim.
5. Whether Claims 8 and 12-16 are patentable under 35 U.S.C. 103(a) over Kim in view of Tsuji, et al. (U.S. Patent No. 5,521,432).

Grouping of Claims

Claims 1-3, 5, and 8-11 stand or fall together. Claims 12-16 stand or fall together. Claims 21 and 22 stand or fall together. Claim 4 stands or falls independently of any other claim. Claim 6 stands or falls independently of any other claim. Claim 23 stands or falls independently of any other claim.

Argument

1. Claim 21 is patentable under 35 U.S.C. 102(e) over Lee, et al. (U.S. Patent No. 6,232,651.)

Claim 21 includes the feature of "a first layer of noble metal covering said leadframe; and a second layer of *said* noble metal covering portions of said first layer of said noble metal (emphasis added)." By virtue of Appellant's use of the word "said" to describe the noble metal of the second layer, the second layer is of the same metal as the first layer in Claim 21. In contrast, Lee discloses a first layer 36 of gold, platinum, or platinum alloy covering the lead frame and a layer 37 of palladium or palladium alloy covering layer 36. Note that layer 37 is a different metal than in Lee's layer 36. Therefore, Lee fails to anticipate Claim 21.

2. Claims 1-3, 5, 9, and 21-23 are patentable under 35 U.S.C. 102(b) over Kim, et al. (U.S. Patent No. 5,767,574).

Claim 1 includes the feature of "an adherent layer of palladium on [a] palladium film." Claim 1 also indicates that the adherent layer of palladium selectively covers areas of the leadframe suitable for bonding wire attachment and solder attachment. Kim does not teach or suggest such features. In Figure 5, Kim shows a Pd-X *alloy* layer over a strike-plated Pd layer, not a layer of palladium on a palladium film. In addition, Appellant cannot find a teaching or suggestion in Kim of selective deposition of *any* layer. Therefore, Appellant submits that Claim 1 is patentable over Kim. Claims 2, 3, 5, and 9 depend from Claim 1 and are therefore patentable over Kim for at least the reasons presented above for that claim.

Claim 21 includes the feature of "a first layer of noble metal covering said leadframe; and a second layer of said noble metal covering portions of said first layer of said noble metal." As noted in Appellant's arguments above distinguishing Claim 21 from Lee, the noble metal of the first layer is the same as the noble metal of the second layer. In contrast, Kim (as in Lee) teaches a different metal (an alloy of palladium and another element such as Au, Co, W, Ag, Ti, Mo, and Sn) overlying a layer of palladium. Therefore, Appellant respectfully submits that Claim 21 is patentable over Kim. Claim 22 depends

from Claim 21 and is therefore patentable over Kim for at least the reasons presented above.

Claim 23 includes the features of "a film of palladium on said leadframe; and a layer of palladium covering portions of said film of palladium." As indicated above with respect to Claim 21, Kim teaches an *alloy* of palladium (i.e. not palladium itself) overlying a layer of palladium. Therefore, Appellant respectfully submits that Claim 23 is patentable over Kim.

3. Claims 21-23 are patentable under 35 U.S.C. 102(b) over Abys, et al. (U.S. Patent No. 5,360,991).

Claim 21 includes the feature of "a first layer of noble metal covering said leadframe; and a second layer of said noble metal covering *portions* of said first layer of said noble metal (emphasis added)." In contrast, in Abys there is nothing to suggest that layer 25 covers only portions of layer 23 rather than the complete layer. Therefore, Appellant respectfully submits that Claim 21 is patentable over Abys. Claim 22 depends from Claim 21 and is therefore patentable over Abys for at least the reasons presented above.

Claim 23 includes the features of "a film of palladium on said leadframe; and a layer of palladium covering *portions* of said film of palladium." As indicated above with respect to Claim 21, in Abys there is nothing to suggest that layer 25 covers only portions of layer 23 rather than the complete layer. Therefore, Appellant respectfully submits that Claim 23 is patentable over Abys.

4. Claims 4, 6, 10, and 11 are patentable under 35 U.S.C. 103(a) over Kim.

Claims 4, 6, 10, and 11 depend from Claim 1. As indicated above, Kim does not teach or suggest all of the features of Claim 1. Therefore, Claims 4, 6, 10, and 11 are patentable under 35 U.S.C. 103(a) over Kim. In addition, Claim 4 includes the feature of "a stack consisting of a nickel layer in the thickness range from about 30 to 50 nm, plated onto said base metal, followed by a

palladium/nickel layer in the thickness range from about 30 to 50 nm, followed by a nickel layer in the thickness range from about 1.0 to 3.0 μm ." In contrast, Kim (col. 1, line 67 to col. 2, line 3) teaches a Ni strike plated layer about 5 μ -inches thick, a Pd/Ni alloy layer about 3 μ -inches, and a Ni layer of undisclosed thickness. There is no suggestion in Kim of using layers having dimensions recited in Claim 4. Claim 6 includes the feature "wherein said palladium layer has a thickness from about 70 nm to 90 nm." As indicated above, Kim's layer 54 in Figure 5 is not a palladium layer. With respect to Claim 11, Appellant points out that "reflow temperature" is a physical characteristic of the solder layer and is therefore not a process limitation as asserted by the Examiner.

5. Claims 8 and 12-16 are patentable under 35 U.S.C. 103(a) over Kim in view of Tsuji, et al. (U.S. Patent No. 5,521,432).

Claim 8 depends from Claim 1. As indicated above, Kim does not teach or suggest all of the features of Claim 1. Tsuji's teaching of a lead frame made of nickel partially plated with palladium does not cure the above-cited defects of Kim. One skilled in the art would receive no motivation from either Kim or Tsuji for a combination of the teachings and suggestions therein to arrive at the features described in Claims 1, 7, or 8. Therefore, Appellants respectfully submit that Claim 8 is patentable over the combination of Kim and Tsuji. Similarly to Claim 11, Appellant points out that providing visual distinction is a characteristic of the palladium layer and is therefore not a process limitation as asserted by the Examiner.

Claim 12 includes the features of "said leadframe further having an adherent layer of palladium on said palladium film, selectively covering said second ends of said lead segments in a thickness suitable for solder attachment, and further selectively covering the bonding wire attachment areas on said first ends of said lead segments in a thickness suitable for bonding wire attachment" As indicated above with respect to Claim 1, Kim does not teach or suggest an adherent layer of palladium on a palladium film. Tsuji does not cure that

deficiency of Kim. Note also that neither Kim nor Tsuji teach or suggest selective deposition of palladium in bonding wire attachment areas of lead segments. In Tsuji's Figures 8 and 9, bonding areas 23 are shown differently than are areas 21. In column 6, at lines 48-54, Tsuji specifies that areas 23 are either silver or gold, not palladium. Claims 13-16 depend from Claim 12 and are therefore patentable for at least the reasons presented above for that claim.

Conclusion

In view of the above, Appellant appeals for the reversal of the rejections and allowance of Claims 1-16 and 21-24.

Respectfully submitted,



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APPENDIX

Claims on Appeal

1. A leadframe for use in the assembly of integrated circuit chips, comprising:
 - a base metal structure having an adherent layer of nickel covering said base metal;
 - an adherent film of palladium on said nickel layer; and
 - an adherent layer of palladium on said palladium film, selectively covering areas of said leadframe suitable for bonding wire attachment and solder attachment.
2. The leadframe according to Claim 1 wherein said base metal is selected from a group consisting of copper, copper alloy, aluminum, iron-nickel alloy, brass, or invar.
3. The leadframe according to Claim 1 wherein said nickel layer has a thickness in the range from approximately 1 to 3 μm .
4. The leadframe according to Claim 1 wherein said nickel layer is a stack consisting of a nickel layer in the thickness range from about 30 to 50 nm, plated onto said base metal, followed by a palladium/nickel layer in the thickness range from about 30 to 50 nm, followed by a nickel layer in the thickness range from about 1.0 to 3.0 μm .

5. The leadframe according to Claim 1 wherein said palladium film has a thickness from about 1 to 5 nm.
6. The leadframe according to Claim 1 wherein said palladium layer has a thickness from about 70 to 90 nm.
7. The leadframe according to Claim 1 wherein said film of palladium is sufficiently thin that the surface of said leadframe not covered by said layer of palladium comprises nickel and nickel oxide as well as palladium.
8. The leadframe according to Claim 1 wherein said palladium layer provides visual distinction to the areas covered by said layer.
9. The leadframe according to Claim 1 wherein said base metal has a thickness between about 100 and 250 μm .
10. The leadframe according to Claim 1 wherein said solder attachment comprises materials selected from a group consisting of tin/lead, tin/indium, tin/silver, tin/bismuth, tin/copper, tin/silver/copper, and conductive adhesive compounds.

11. The leadframe according to Claim 10 wherein said solder layer has a reflow temperature compatible with wire bonding temperatures and molding temperatures.

12. A semiconductor device comprising:

a leadframe comprising a chip mount pad for an integrated circuit chip and a plurality of lead segments, each segment having a first end near said mount pad and a second end remote from said mount pad;

said leadframe having an adherent layer of nickel;

said leadframe further having an adherent palladium film on said nickel layer;

said leadframe further having an adherent layer of palladium on said palladium film, selectively covering said second ends of said lead segments in a thickness suitable for solder attachment, and further selectively covering the bonding wire attachment areas on said first ends of said lead segments in a thickness suitable for bonding wire attachment;

an integrated circuit chip attached to said mount pad;

bonding wires interconnecting said chip and said first ends of said lead segments; and

encapsulation material surrounding said chip, bonding wires and said first ends of said lead segments, while leaving said second ends of said lead segments exposed.

13. The device according to Claim 12 wherein said bonding wires are selected from a group consisting of gold, copper, aluminum and alloys thereof.

14. The device according to Claim 12 wherein the bonding wire contacts to said first ends of said lead segments comprise welds made by stitch bonds, ball bonds, or wedge bonds.

15. The device according to Claim 12 wherein said encapsulation material is selected from a group consisting of epoxy-based molding compounds suitable for adhesion to said leadframe.

16. The device according to Claim 12 further comprising lead segments having said second ends bent, whereby said segments obtain a form suitable for solder attachment.

21. A semiconductor device, comprising:

 a leadframe, comprising:

 a first layer of noble metal covering said leadframe; and

 a second layer of said noble metal covering portions of said first layer of said noble metal, wherein said first layer of said noble metal is thinner than said second layer of said noble metal.

22. The semiconductor device of Claim 21, wherein said noble metal is palladium.

23. A semiconductor device, comprising:

a leadframe, comprising:

a film of palladium on said leadframe;

a layer of palladium covering portions of said film of palladium.

24. The semiconductor device of Claim 23, further comprising a layer of nickel on said leadframe onto which said film of palladium is deposited, wherein said film of palladium is sufficiently thin that the surface of said leadframe not covered by said layer of palladium comprises nickel and nickel oxide as well as palladium.